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Study of incidence and outcomes of infection among patients in intensive care units at a tertiary hospital

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Abstract

Background: Infection is a major cause of admissions and prolonged stays in intensive care units (ICUs). Prevalence of ICU infections varies between 45% to 58% and incidence rates between 30 to 35%. Present study was aimed to study of prevalence and outcomes of infection among patients in intensive care units at a tertiary hospital. **Material and Methods:** Present study was single-center, prospective, observational study, conducted in patients of age 19-79 years, either gender, had no evidence of infection at the time of admission, staying for more than 48 h in the ICU. **Results:** In present study, during study period out of 760 patients studied, incidence of infection among patients in intensive care units was 15.92 % (n=121). Majority were from 60-69 years (28.1 %) & 50-59 years (26.45 %) age group. Male (60.33 %) outnumbered female (39.67 %). Mean length of ICU stay was 13.28 ± 5.59 days, while mean length of hospital stay was 22.17 ± 11.06 days. Common associated risk factors noted among the infected patients were central venous catheter (95.87 %), urinary catheter (95.87 %), peripheral venous line (85.95 %), arterial line (85.95 %), nasogastric tube (80.17 %), mechanical ventilator (63.64 %), endotracheal intubation (56.2 %), hypoalbuminemia (55.37 %), diabetes mellitus (47.93 %), malnutrition (31.4 %), tracheostomy (24.79 %) & immunocompromised (23.97 %). Urinary tract infections (28.93 %), bloodstream infections (25.62 %), respiratory infections other than VAP (20.66 %), ventilator-associated pneumonia (VAP) (17.36 %) & surgical site infection (17.36 %) were noted among study patients. We noted statistically significant mortality among patients with infection as compared to patients without infection (39.67 % vs 17.53 %) ($p<0.001$). **Conclusion:** Infection among patients in intensive care units was common in male, elderly patients, had catheterization, received mechanical ventilation or were intubated.

Keywords: Infection, intensive care unit, catheterization, mechanical ventilation, intubation.

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Introduction

Infection is a major cause of admissions and prolonged stays in intensive care units (ICUs). Prevalence of ICU infections varies between 45% to 58% and incidence rates between 30 to 35%.[1] Sepsis is the leading cause of death in non-coronary intensive care units and the 10th leading cause of death overall.[2] Despite the availability of potent antibiotics and refined

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supportive care, the mortality of septic patients remains high with overall estimates to 30% and increasing to 50% when associated with shock.[3]

The WHO estimates that the rate of hospital‐acquired infections (HAIs) is 7%–12% among hospitalized patients all over the world, where >1.4 million people had infection‐related complications during their stay in the hospital at any time.[4,5]Most infections which become clinically evident after 48 hours of hospitalization are hospital-acquired. Infections which occur after the discharge of the patient from the hospital is healthcare-associated if the organisms were acquired during the hospital stay.

The length of stay for patients with sepsis or severe sepsis is prolonged and both the direct health care costs of hospitalization and economic costs of post sepsis care are extensive.[3] Despite better understanding of sepsis pathophysiology and improved management through multiple modalities, the incidence continues to increase and fatality rates remain unacceptably high. Present study was aimed to study of prevalence and outcomes of infection among patients in intensive care units at a tertiary hospital.

Material And Methods

Present study was single-center, prospective observational study, conducted in department of general medicine, at XXX medical college & hospital, XXX, India. Study duration was of 6 months (January 2022 to June 2022). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients of age 19-79 years, either gender, had no evidence of infection at the time of admission, staying for more than 48 h in the ICU, willing to participate in present study

Exclusion criteria

- Patients with pre-existing central line or indwelling urinary catheters
- Patients with known immunocompromised status (HIV, malignancy, on immunosuppressants)

Study was explained to patients in local language & written consent was taken for participation & study. Clinical history, relevant physical examination, primary diagnosis, and demographic details of all the enrolled patients were obtained. Baseline CBC, Biochemical tests, markers, cultures, chest X ray and other relevant radiological investigations for all the patients were done on admission.

Admitted patients were monitored daily for development of infection during hospital stay. Identification of infection was done based on clinical suspicion and subsequent diagnostic tests. Diagnosis of HAI was based on the Centre for Disease Control diagnostic criteria. The first 100 consecutive patients diagnosed with HAI were enrolled in the study. Antimicrobial therapy was administered to the patients as necessary and cultures were requisitioned when infection was suspected. Patients were always sampled for microbial culture before starting a new antimicrobial. Appropriate essential investigations were regularly performed as needed.

Specific site cultures were also sent on suspicion of infection. Various pathogenic organisms isolated on culture were recorded. Bacterial isolates were subjected to gram staining, hanging drop for motility, catalase and oxidase tests. Their identity was established by a battery of biochemical tests like fermentation of sugars, indole test, citrate utilization test, urease production test and production of H2S on TSI as per standard protocol. Antibiotic susceptibility testing was performed by Kirby- Bauer’s disk diffusion method on Muller-Hinton agar (Hi Media, Mumbai, India) in accordance with the standards of the Clinical Laboratory Standards Institute (CLSI—formerly National Committee for Clinical Laboratory Standards [NCCLS]) guidelines.

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Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

Results

In present study, during study period out of 760 patients studied, incidence of infection among patients in intensive care units was 15.92 % (n=121). Majority were from 60-69 years (28.1 %) & 50-59 years (26.45 %) age group. Male (60.33 %) outnumbered female (39.67 %). Mean length of ICU stay was 13.28 ± 5.59 days, while mean length of hospital stay was 22.17 ± 11.06 days. Majority were admitted due to surgical (32.23 %), cardiovascular (15.7 %), renal (13.22 %) & respiratory (12.4 %) causes.

Table 1: General characteristics

	No. of patients	**Percentage**
Age groups (in years)		
19-29	8	6.61
30-39	14	11.57
40-49	17	14.05
50-59	32	26.45
60-69	34	28.1
70-79	16	13.22
Mean age (mean±SD)	59.19 ± 11.34	
Gender		
Male	73	60.33
Female	48	39.67
Others		
Length of ICU stay (days)	13.28 ± 5.59	
Length of hospital stay (days)	22.17 ± 11.06	
Primary cause of ICU admission		
Surgical	39	32.23
Cardiovascular	19	15.7
Renal	16	13.22
Respiratory	15	12.4
Neurological	11	9.09
Gastrointestinal	11	9.09
Metabolic	10	8.26

In present study, common associated risk factors noted among the infected patients were central venous catheter (95.87 %), urinary catheter (95.87 %), peripheral venous line (85.95 %), arterial line (85.95 %), nasogastric tube (80.17 %), mechanical ventilator (63.64 %), endotracheal intubation (56.2 %), hypoalbuminemia (55.37 %), diabetes mellitus (47.93 %), malnutrition (31.4 %), tracheostomy (24.79 %) & immunocompromised (23.97 %).

Table 2: Associated risk factors among the affected patients (*n* = 100)

Associated risk factors	**No. of patients**	**Percentage**
Central venous catheter	116	95.87
Urinary catheter	116	95.87
Peripheral venous line	104	85.95
Arterial line	104	85.95
Nasogastric tube	97	80.17
Mechanical ventilator	77	63.64

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Endotracheal intubation	68	56.2
Hypoalbuminemia	67	55.37
Diabetes mellitus	58	47.93
Malnutrition	38	31.4
Tracheostomy	30	24.79
Immunocompromised status	29	23.97
Chronic renal failure	17	14.05
Re-intubation	13	10.74
Surgery	13	10.74
Pulmonary artery catheter	7	5.79
Chronic alcoholism	5	4.13

Urinary tract infections (28.93 %), bloodstream infections (25.62 %), respiratory infections other than VAP (20.66 %), ventilator-associated pneumonia (VAP) (17.36 %) & surgical site infection (17.36 %) were noted among study patients.

Table 3: Type of infections among the infected group (*n* = 100)

Type of NI	No. of patients	Percentage
Urinary tract infections	35	28.93
Bloodstream infections	31	25.62
Respiratory infections other than VAP	25	20.66
Ventilator-associated pneumonia (VAP)	21	17.36
Surgical site infection	21	17.36

We noted statistically significant mortality among patients with infection as compared to patients without infection
(39.67 % vs 17.53 %) ($p<0.001$).

Table 4: Comparison of mortality of study patients.

Parameter	Died	Survived	p-value
No. of patients with infection (n=121)	48 (39.67 %)	73 (60.33 %)	0.001
No. of patients without infection (n=639)	112 (17.53 %)	527 (82.47 %)	

Discussion

It has been reported that the incidence of nosocomial infections in the intensive care unit (ICU) is about 2 to 5 times higher than in the general in-patient hospital population.[5] The increased morbidity and mortality associated with nosocomial infections in the ICU is a matter of serious concern today. Healthcare associated infections (HAIs), also known as hospital acquired infections or nosocomial infections are one of the leading causes of morbidity and mortality among hospitalized patients. The nosocomial infection is more common in elderly, immunosuppression, diabetics, renal failure, family members with MDR organisms.[6]

ICU nosocomial infections are primarily related to the patients' health status; invasive device utilization such as venous central line, urinary catheterization, and mechanical ventilation; use of immunosuppressors; prolonged hospitalization; colonization by resistant microorganisms; and indiscriminate use of antibiotics.[7]

Ventilator-Associated Pneumonia risk factors include oropharyngeal and gastric colonization, thermal injuries; posttraumatic, postsurgical intervention factors such as emergency intubation, reintubation, tracheostomy, bronchoscopy and inserting nasogastric tube; patients'

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body positioning, level of consciousness, stress ulcer prophylaxis, and use of medications, including sedative agents, immunosuppression and antibiotics.[8,9]

In study by Behera B et al.,[10] mechanical ventilator utilization ratios of adult medical and surgical ICUs were 0.32 and 0.26, respectively ($p<0.001$). About 8 and 7 episodes of infection-related ventilator-associated complication (IVAC) and 14 and 6 episodes of possible ventilator-associated pneumonia (PVAP) were reported from adult medical and surgical ICUs, accounting for IVAC rates of 3.17 and 1.8 per 1,000 MV ($p>0.05$) and PVAP rates of 2.46 and 1.59 per 1,000 MV days in medical and surgical ICUs, respectively ($p>0.05$). Acinetobacter baumannii complex either singly or in combination was isolated in 11/20 PVAP cases.

Reddy PS et al.,[11] studied 260 patients, prevalence of nosocomial infections was 19.2%. Female subjects were more affected (60%) than male subjects (40%). Risk factors identified were urinary catheterization, female sex, advanced age, mechanical ventilation, and increased hospitalization. Ventilator-associated pneumonia was the most common NI, constituting 36%, followed by urinary tract infections (26%). Escherichia coli were the predominant organisms among the Gram-negative bacteria. Imipenem was majorly used antibiotic for empirical treatment of ICU infections before getting the antibiotic sensitivity report.

Wasi S et al.,[12] studied 110 HAIs with 10 patients having two infections each. 69 patients had ventilator associated pneumonia (VAP), 21 patients had catheter associated urinary tract infection (CAUTI) patients, 20 patients had central line associated bloodstream infection (CLABSI), and 10 patients had both VAP and CAUTI. All of the HAIs were device associated. 76 pathogens were isolated on culture. No organism was isolated in 40 HAI. Majority (94.7%) of the organisms were gram-negative and all were multidrug resistant. 77 of the enrolled patients expired while 23 patients were discharged from the hospital.

In study by Babbar P et al.,[13] among 100 patients observed, 29 % developed 52 episodes of HAI. VAP was the commonest HAI (62%), followed by CLABSI and CAUTI. Pseudomonas aeruginosa was isolated in 27.6% followed by Staphylococcus haemolyticus and E. coli. Results showed that patients admitted with higher APACHE II score developed HAI significantly more than patients admitted with a lower score. Significantly higher mortality was observed in patients with HAI. The results showed that patients who developed a HAI stayed in the hospital for an average of 11.96 days more than matched controls.

The EPIC II study[14] reported medical admission, admission after emergency surgery or trauma, referral from the hospital floor, emergency room, or other hospital, the presence of chronic obstructive pulmonary disease, cancer, HIV, older age, mechanical ventilation, renal replacement therapy and greater SAPS II score were found to be independently associated with a higher risk of infection.

Indeed, antimicrobial resistance is associated with delays to adequate antimicrobial therapy, increased mortality, resource utilization and costs.[15,16] It leads to considerable increases in the use of broad-spectrum antimicrobials which in turn exacerbates the problem by selecting antimicrobial resistant micro-organisms. It has been reported that in hospitals with an effective program for nosocomial infection surveillance, infection rates can be reduced by approximately one-third.[16]

Conclusion

Infection among patients in intensive care units was common in male, elderly patients, had catheterization, received mechanical ventilation or were intubated. Health-care-associated infection prevention programmes, early detection strategies, and appropriate antibiotic and fluid management strategies for the treatment of sepsis are critical.

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